

March 30, 1959

GUS-0205

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PROGRESS REPORT NO. 2

by

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AIRFRAME MANUFACTURER COORDINATION

Two additional technical coordination meetings (the 4th and the 5th) have been held since the last Progress Report (February 11, 1959). During these, we have reached agreement on the performance rating and measuring technique to be used for engines built to the "Operational Training Suitability Test" design and the "Qualification Test" design. A rating table*, plus explanatory notes, has been prepared for inclusion into the Model Specification**. The most important part of the performance rating is considered to be the cruise specific fuel consumption and the following discussion is concerned with this characteristic. The basis of the agreement is as follows:

1. The original cruise specific fuel consumptions for the engine (Marquardt Report No. 5705, dtd. 21 May 1958) were nominal values.
2. Estimates and analyses indicate that manufactured engines will have a maximum expected deviation from the nominal of $\pm 2 \frac{1}{2}\%$.
3. Application of statistical analysis techniques indicates that in the manufacture of a statistically significant number of engines 5% might have deviations greater than the $2 \frac{1}{2}\%$ maximum and would have to be reworked. For those engines delivered to the OTST design, 52% could be expected to have nominal performance or better and an additional 31% might have a positive deviation not more than $1 \frac{1}{4}\%$ from nominal and an additional 17% might have a positive deviation not more than $2 \frac{1}{2}\%$ from nominal. (Total engines delivered = 100%)
4. By suitable instrumentation and testing techniques involving multiple independent measurements, instrumentation error during Acceptance Testing of the engines (relative to cruise specific fuel consumption, at least) will be essentially eliminated such that delivery guarantees for the OTST design would be based upon the distribution indicated under (3.) above - each engine's rating being indicated in its log book.
5. "Qualification" design engines would all have current "nominal" cruise specific fuel consumption or better. This would be made possible by a continuing development program which would raise the true nominal performance of the engine and narrow the random deviation band.

Requirements relative to other rating points of the engine, such as ignition, maximum accelerating thrust, and maximum continuous power, have been agreed upon tentatively and are summarized in the notes and rating table* of the specification*.

* Rating Table - Register No. 0081, dtd Feb. 20, 1959.

**Model Specification - Register No. 0008, dtd Feb. 11, 1959.

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Engine life requirements and endurance testing estimates have also been agreed upon and are summarized in our Register No. 0090.** Most of the engine structure will be designed for a life of 15 missions (25 hours)*. Endurance testing equal to 523 equivalent missions (873 hours) will have been accomplished with structural engines at the OTST point in the program. The Operational Training Suitability Test itself will consist of six simulated missions which are to include one high altitude mission and one emergency return.

Most technical coordination over the past month and a half, relative to the engine specification, has had to do with the above areas of engine life and performance rating. Other features of the specification are generally agreed upon but will require further discussion before they are finally established.

We are currently working with the airframe manufacturer to arrive at an engine delivery schedule to assist in our future program planning and in preparation of a proposal currently underway for the manufacturing of the block of engines to be delivered starting at the 19th month. We should be under contract to build these engines by mid-June if the 19th month schedule is to be held.

CUSTOMER COORDINATION

In accordance with a request at our technical review on March 24th, we are preparing an estimate of costs to continue beyond May 15th on two bases:

1. Minimum rate to hold the staff together and let the schedule slip.
2. Rate required to maintain schedule.

We met with various of the customer's representatives on March 12th and reviewed our requirements for test facilities, special test equipment, and machine tools. These requirements have been further summarized in a letter to Mr. James McDonald, from Mr. O. B. McCutcheon, subject "Government Furnished Facilities, Tools, and Test Equipment". Two types of action relative to this equipment are required:

1. In the case of the facilities, a technique must be developed for short-cutting established Air Force procedures.
2. In the case of the machine tools, we need access to the reserve lists and authorization to inspect reserve tools as soon as possible in order to minimize possible expenditures for new tools. Action on this currently awaits our submittal of a detailed machine tool list. Current plans are that this list should reach you about the same time as this progress report.

We are currently having a budgetary problem and find that we are under-budgeted to complete the first 4 1/2 months work in a manner that will preserve the 19-month and 25-month program schedule points. In order to stay within the established

*Certain replaceable parts of the engine - such as burner cans and liners and variable exit parts - will be designed for 9 equivalent missions (15 hours).

**Register No. 0090, dtd March 6, 1959.

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budget, we are having to cut out component testing, some advanced material orders, and some special test equipment orders which, by the 15th of May, would have totaled \$440,000. About \$200,000 of this might be considered expenditure rate increase on our part relative to the original plan, while the other \$240,000 of the amount is attributable to matters beyond our control - such as a two week extension of time from 4 to 4 1/2 months, extra costs not anticipated relative to security, and the necessity of buying wind tunnel time due to unavailability of AEDC Facility.

ADMINISTRATIVE

The engineering and administrative personnel, etc., for the project, have been located at the Hayvenhurst School building, 6950 Hayvenhurst, since February 23, 1959. The company has rented the structure and grounds for six months with an option to renew for three one-year periods beyond that time. There are now 133 employees at the school. A closed manufacturing area of 3,500 sq ft has been established at the main plant in a detached building. It is currently accessible to 22 people by coded cards.

Security checks have been requested for a total of 269 people to this date (25 of these have been requested to be deleted).

The proposal for the 25-month development program has been completed and is being given final management checks prior to mailing. A proposal for manufacture of the Flight Readiness Test design engines (first delivery at the 19-month point) is being prepared with a target mailing date of 15 April 1959.

LIAISON CONDUCTED - 11 February to 31 March 1959

Date	Place	Representation Additional to Engine Manufacturer	Purpose
Feb. 11, 12	Ft. Worth	Airframe manufacturer	4th coordination meeting
March 3, 4, 5	Van Nuys	Airframe manufacturer	5th coordination meeting
March 12	Washington, D.C.	Customer	Test facilities and machine tools
March 13	Ft. Worth	Airframe manufacturer	Special problem
March 20	Van Nuys	Airframe manufacturer Customer	Technical review
March 24	Washington, D.C.	Customer Airframe manufacturer	Technical review
March 31	Tullahoma, Tenn.	AEDC	Test schedule coordination

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An exit nozzle test program was initiated at the Hydronic Engineering Corporation wind tunnel in Minneapolis, Minnesota, early in March. Nine different configurations are to be evaluated during 75 test runs. Basic configurations being tested include the following:

Sliding	Convergent Divergent Plug
Sliding	Cut-off Plug
Fixed	Convergent Divergent Plug
Fixed	Cut-off Plug

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The 30-inch diameter test engine has been run at M=2.11 at conditions simulating ramjet takeover ($M = 2$, 36,000 feet). The combustion configuration was the same as was tested at OAL last August. Results indicated difficult ignition and low efficiencies at this test condition. Accordingly, small scale tests were run on a modified fuel injection and burner can front end design. It appeared to overcome the deficiencies of the original design. The 30-inch engine was modified accordingly and additional tests have indicated improved stability, ignitability, as well as even burning among the three burner cans. Combustion efficiency was some better, but requires further improvement.

Suitable samples of Rene 41 sheet material have been received and are undergoing tests in our Materials & Process Laboratory to establish the tensile and creep strength of the basic material as well as of various joining methods such as fusion flash welding and resistance welding. Formability studies with Rene 41 and other candidate alloys, such as U-500, M-252, R-235, are in progress.

FIRST ENGINE STRUCTURE AND MOCK-UP

Design of the first engine is estimated to be approximately 30% complete. Rene 41 sheet material is due to arrive this week - such that parts fabrication can begin. The mock-up to be delivered the end of June is 80% designed and 10% fabricated.

FUEL SYSTEMS AND CONTROLS

A schematic of the fuel and control system has been established in conformance with requirements of our own as well as of the airframe manufacturer. Equipment contained within the engine centerbody is as follows - in order from front to back:

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Air flow and temperature sensing probes
High energy ignition box
Air mass flow computer
Manual control section
Inner and outer ring fuel flow regulators and main fuel pump
Exit actuator boost pump
Exit control and actuators

The ramp system to be located near the diffuser inlet will consist of two identical inlet controls and two parallel sets of actuators.

The by-pass door system, to be located near the forward part of the subsonic duct, will consist of a shock positioner control and door actuators.

Final casting design is underway in accordance with this schematic arrangement. Servo valves - diaphragms, pressure dividers and other internal components of the various fuel system and control units will be adapted from those used with the Bomarc engine.

First flight package hardware is scheduled for bench evaluation 1 October 1959.

An important feature relative to detailed design requirements of the components is resolution of pilot's function relative to engine control. (A section of the engine model specification is devoted to this subject). While general agreement has been reached on pilot's functions, there are areas still under study by both us and the airframe manufacturer. A recent change has been made, with agreement by all, which results in the pilot's control lever operating directly to command exhaust gas total temperature rather than exit nozzle position as formerly planned.

Material tests have verified the capabilities of a silicone-fiberglass diaphragm material to withstand 500° fuel for over 50 hours. Most of our testing has been with flat sheets; however, one test with a simple molded diaphragm shows similar capabilities. This testing will be continued with the more complex shapes required in the control. Such material as silicone rubber will probably be adequate for static "O" ring seals and will be evaluated with sliding seals under 500° fuel temperature conditions.

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9 MAR 1959

Letter Contract No.
Amendment No. 2

25X1

Marquardt Aircraft Company
Van Nuys, California

Gentlemen:

1. This document constitutes Amendment No. 2 to Letter Contract No. between Marquardt Aircraft Company and the United States Government and said contract is amended as hereinafter set forth.

25X1

2. Paragraph 5 of the Contract is amended by deleting the figures "\$500,000.00" appearing in the second line thereof, and in lieu thereof substitute the figures "\$1,000,000.00".

3. As a result of the foregoing, there is a total amount of \$1,000,000.00 allotted to the contract. All other terms and conditions of the contract remain unchanged.

4. Please indicate your receipt of this Amendment No. 2 to Letter Contract No. and your acceptance thereof by executing the original and two copies of this Amendment. Return the fully executed original and one copy thereof to the undersigned and retain the remaining copy for your files.

25X1

Very truly yours,

25X1

Contracting Officer

ACKNOWLEDGED AND ACCEPTED
MARQUARDT AIRCRAFT COMPANY

BY

TITLE Assistant Secretary

DATE March 31, 1959

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